

NASA SBIR/STTR Technologies
Proposal No. T8.01-9920 - Ultraefficient Thermoelectric Devices
PI: Mr. Paul F. Hines
MicroXact Inc. Blacksburg, VA



Identification and Significance of Innovation

New high conversion efficiency TE devices, as well the manufacturing methods need to be developed to meet the growing NASA, DoD and commercial needs in thermoelectric energy. The team of MicroXact Inc., Sundew Technologies Inc. and Virginia Tech is proposing to develop a revolutionary ultrahigh efficiency thermoelectric material fabricated on completely new fabrication principles. The material comprises the three-dimensional $\text{Bi}_2\text{Te}_3/\text{Sb}_2\text{Te}_3$ Quantum Well Superlattices fabricated by a conformal coating of macroporous silicon (MPSi) pore walls. Such a material will provide $ZT > 2$ at macroscopic thicknesses of the material, permitting 15% or more conversion efficiencies

Expected TRL Range at the end of Contract (1-9): 5

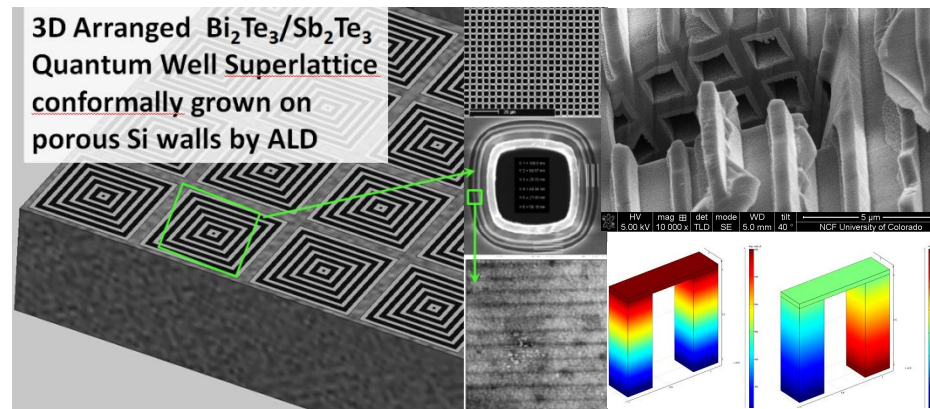
Technical Objectives and Work Plan

Technical Objectives:

- EO1 - Develop the model of 3D QDS array on macroporous silicon walls.
- EO2 - Prove the feasibility of the proposed concept by modeling/simulations.
- EO3 - Prove the feasibility of key processes.
- EO4 - Develop strategies for product commercialization and transition to manufacturing.

Work Plan:

- ETask 1 - Develop the theoretical model of the proposed material .
- ETask 2 - Design the thermoelectric device to meet 30% efficiency goal and validate the performance through simulations/modeling .
- ETask 3 - Develop the process of macroporous silicon fabrication.
- ETask 4 - Develop the process of QDS growth on macroporous silicon pore walls and demonstrate conformal coating of pore walls with a single-layer QDS.
- ETask 6 - : Develop the concept of Phase II, commercialization strategy, and transition to manufacturing.



NASA and Non-NASA Applications

- EPower generation on board of spacecraft (NASA).
- ECooling of electronic components (NASA, DoD, commercial).
- EWaste heat recovery (NASA, DoD, commercial).
- EResidential cooling and refrigeration (commercial).
- EIndustrial Waste Heat, Arc Furnaces, Smelting Cells, etc. (commercial)
- EPremium Portable Power (DoD, commercial)
- EWaste Heat, Geothermal Power Plants (DoE, commercial).

Firm Contacts

Dr. Vladimir Kochergin, Vice President of Operations, MicroXact.,
 (614) 917-7202, vkochergin@microxact.com
 Mr. Paul F. Hines, President/CEO, MicroXact, (540) 392-6917,
phines@microxact.com

NON-PROPRIETARY DATA